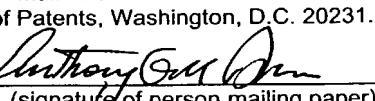


FORM PTO-1390 (Rev 5-93)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER ZAHFRI P422US														
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S APPLICATION NO. (If known, see 37 CFR 15) 10/089476															
INTERNATIONAL APPLICATION NO PCT/EP00/09990	INTERNATIONAL FILING DATE October 11, 2000	PRIORITY DATE CLAIMED October 16, 1999															
TITLE OF INVENTION CONTINUOUSLY VARIABLE VEHICLE TRANSMISSION																	
APPLICANT(S) FOR DO/EO/US Gerhard GUMPOLTSBERGER																	
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:																	
<p>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</p> <p>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))</p> <ul style="list-style-type: none"> a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau. (PCT/IB/308 mailed 26 April 2001). c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US) <p>6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)) is attached.</p> <p>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))</p> <ul style="list-style-type: none"> a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). b. <input type="checkbox"/> have been transmitted by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input checked="" type="checkbox"/> have not been made and will not be made. <p>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p>																	
Items 11. to 16. below concern other document(s) or information included:																	
<p>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98 with PTO FORM 1449.</p> <p>12. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment.</p> <p><input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</p> <p>14. <input type="checkbox"/> A substitute specification w/Marked-Up Version of Amended Specification.</p> <p>15. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>16. <input checked="" type="checkbox"/> Other items or information:</p> <table border="0"> <tr> <td><input checked="" type="checkbox"/> Preliminary Examination Report</td> <td><input checked="" type="checkbox"/> Copy of Request</td> </tr> <tr> <td><input checked="" type="checkbox"/> Annexes to Pre. Ex. Rep.</td> <td><input checked="" type="checkbox"/> Submission of Formal Drawings</td> </tr> <tr> <td><input checked="" type="checkbox"/> International Search Report</td> <td><input checked="" type="checkbox"/> <u>3</u> sheets of formal drawings</td> </tr> <tr> <td><input checked="" type="checkbox"/> German Novelty Search Report</td> <td><input checked="" type="checkbox"/> Abstract</td> </tr> <tr> <td><input checked="" type="checkbox"/> <u>10</u> copies of citations</td> <td><input checked="" type="checkbox"/> Applicant Claims Small Entity Status</td> </tr> <tr> <td><input checked="" type="checkbox"/> Form PCT/IB/308</td> <td><input type="checkbox"/> Copy of Notification of File Missing Parts</td> </tr> <tr> <td><input checked="" type="checkbox"/> International Publ. No. <u>WO 01/29451</u> (Face page only)</td> <td><input checked="" type="checkbox"/> German Language Specification</td> </tr> </table>				<input checked="" type="checkbox"/> Preliminary Examination Report	<input checked="" type="checkbox"/> Copy of Request	<input checked="" type="checkbox"/> Annexes to Pre. Ex. Rep.	<input checked="" type="checkbox"/> Submission of Formal Drawings	<input checked="" type="checkbox"/> International Search Report	<input checked="" type="checkbox"/> <u>3</u> sheets of formal drawings	<input checked="" type="checkbox"/> German Novelty Search Report	<input checked="" type="checkbox"/> Abstract	<input checked="" type="checkbox"/> <u>10</u> copies of citations	<input checked="" type="checkbox"/> Applicant Claims Small Entity Status	<input checked="" type="checkbox"/> Form PCT/IB/308	<input type="checkbox"/> Copy of Notification of File Missing Parts	<input checked="" type="checkbox"/> International Publ. No. <u>WO 01/29451</u> (Face page only)	<input checked="" type="checkbox"/> German Language Specification
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CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this Transmittal Letter and the papers indicated as being transmitted therewith is being deposited with the United States Postal Service on this date **March 28, 2002** in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number EL 918840098 US addressed to the: Box PCT, Assistant Commissioner of Patents, Washington, D.C. 20231.

Anthony G. M. Davis
(typed or printed name of person mailing paper)


(signature of person mailing paper)



020210

				CALCULATIONS	PTO USE ONLY
17. ■ The following fees are submitted: Basic National Fee (37 CFR 1.492(a)(5): Search Report has been prepared by the EPO or JPO \$890.00 International preliminary examination fee paid to USPTO (37 CFR 1.492)(a)(1) ... \$710.00 No international preliminary examination fee paid to USPTO (37 CFR 1.492)(a)(2) but international search fee paid to USPTO (37 CFR 1.445(a)(2)). \$740.00 Neither international preliminary examination fee (37 CFR 1.492)(a)(3) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$1040.00 International preliminary examination fee paid to USPTO (37 CFR 1.492)(a)(4) and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 ENTER APPROPRIATE BASIC FEE AMOUNT =				890	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				0	
Claims	Number Filed	Number Extra	Rate		
Total Claims	10 - 20 =	0	x \$18.00	0	
Independent Claims	1 - 3 =	0	x \$84.00	0	
Multiple dependent claim(s) (if applicable)				+ \$280.00	0
TOTAL OF ABOVE CALCULATIONS =				0	
Reduction by 1/2 for filing by small entity, if applicable. Applicant Claims Small Entity Status. (Note 37 CFR 1.9, 1.27, 1.28).				0	
SUBTOTAL =				890	
Processing fee of \$130.00 for furnishing the English translation later the <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				0	
TOTAL NATIONAL FEE =				0	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				+ 40	
TOTAL FEES ENCLOSED =				930	
				Amount to be: refunded	\$
				charged	\$
a. ■ A check in the amount of <u>\$ 930.00</u> to cover the above fees is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. <u>04-0213</u> in the amount of \$ ____ to cover the above fees. A duplicate copy of this sheet is enclosed. c. ■ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>04-0213</u> . A duplicate copy of this sheet is enclosed.					
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO: <u>Anthony G. M. Davis</u> Anthony G. M. Davis - Registration No. 27,868 Davis & Bujold, P.L.L.C. Fourth Floor 500 North Commercial Street Manchester, NH 03101-1151 Telephone (603) 624-9220 Telefax (603) 624-9229					
PATENT & TRADEMARK OFFICE  020210					

03/28/02

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of : Gerhard GUMPOLTSBERGER
Serial no. :
For : CONTINUOUSLY VARIABLE VEHICLE
Docket : ZAHFRI P422US

BOX PCT

The Commissioner of Patents and Trademarks
Washington, D.C. 20231

FIRST PRELIMINARY AMENDMENT

Dear Sir:

By way of preliminary amendment, please amend the above identified application as set forth below.

In the Specification:

Please cancel paragraphs 2, 4, 9, 10, 21, 22 and 29 of the specification, in their entirety, in favor of a clean form of paragraphs 2, 4, 10, 21, 22 and 29 of the specification, without any markings thereon, as follows. Accompanying this response is a copy of the original paragraphs of the specification which show the additions (by underlining and bold) and the deletions (by strikeout) to the canceled specification paragraphs. Please enter the replacement specification paragraphs into the record of this case.

In the Claims:

Please cancel claims 1-12, without prejudice or disclaimer of the subject matter therein, in favor of new claims 13-24 as follows.

[002] FIELD OF THE INVENTION

[004] BACKGROUND OF THE INVENTION

[010] SUMMARY OF THE INVENTION

[021] BRIEF DESCRIPTION OF THE DRAWINGS

[022] The invention will now be described, by way of example, with reference to the accompanying drawings in which:

[029] DETAILED DESCRIPTION OF THE INVENTION

13. (NEW) A continuously variable vehicle transmission (1) having a variator (2, 3, 23) transmission for continuously variable ratio adjustment and a multi-step transmission (4) with at least one input shaft (7) and an output shaft (8) shaft and at least two forward gears and at least one reverse gear, wherein in said multi-step transmission (4) a reversal of direction of rotation takes place between said input shaft (7) and said output shaft (8) using the at least two forward gears and the at least one reverse gear takes place without reversal of direction of rotation between said input shaft and said output shaft (11).

14. (NEW) The continuously variable vehicle transmission according to claim 13, wherein as variator comprises one of a cone pulley belt drive transmission (2) and a two-way toroidal drive (3) having input shafts (5, 16) and output shafts (6, 21) exhibiting the same direction of rotation, and wherein the output of the multi-step transmission (4), is reversed in its direction of rotation by a gear set (12).

15. (NEW) The continuously variable vehicle transmission according to claim 14, wherein said input shafts (5, 6) of said variator (2, 3) and said output shafts (16, 21) of said multi-step transmission (4) are disposed side by side in parallel.

16. (NEW) The continuously variable vehicle transmission according to claim 13, wherein said variator a one-way toroidal drive (23) and a reversal of direction of rotation takes place in said variator (23) between an input shaft (5) and said output shaft (6) of the drive (23).

17. (NEW) The continuously variable vehicle transmission according to claim 16, wherein said shafts (5, 6) of said variator (23) and said shafts (7, 8) of said multi-step transmission (4) are disposed coaxially consecutively.

18. (NEW) The continuously variable vehicle transmission according to claim 13, wherein said input shaft (7) and said output shaft (8) of said transmission (4) are coaxial to each other and situated on one or both sides of a housing of said transmission (4).

19. (NEW) The continuously variable vehicle transmission according to claim 13, wherein said multi-step transmission (4) is a planetary transmission.

20. (NEW) The continuously variable vehicle transmission according to claim 13, wherein a shift clutch of said multi-step transmission (4) is a starting clutch.

21. (NEW) The continuously variable vehicle transmission according to claim 13, wherein said multi-step transmission (4) is power-shiftably designed.

22. (NEW) The continuously variable vehicle transmission according to claim 13, wherein two forward drive ranges are shiftable and have an overlapping range (27).

23. (NEW) The continuously variable vehicle transmission according to claim 14, wherein two forward drive ranges are shiftable and have an overlapping range (27).

24. (NEW) The continuously variable vehicle transmission according to claim 23, wherein a change of the drive range as group shifting is possible, there simultaneously occurring a stepped shift in said multi-step transmission (4) and a ratio adjustment of said variator (2, 3, 23).

REMARKS

Accompanying this response, please find marked-up paragraphs of the specification which overcome some informalities noted in the specification. The undersigned avers that the enclosed replacement paragraph(s) of the specification do not contain any new matter.

Please consider new claims 13-24 upon consideration of this application.

In the event that there are any fee deficiencies or additional fees are payable, please charge the same or credit any overpayment to our Deposit Account (Account No. 04-0213).

Respectfully submitted,



Anthony G.M. Davis, Reg. No. 27,868

Customer No. 020210

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[001] CONTINUOUSLY VARIABLE VEHICLE TRANSMISSION

[002] **FIELD OF THE INVENTION**

[003] The invention relates to a continuously variable vehicle transmission having one variator such as a toroidal drive or a cone pulley belt drive for continuously variable ratio and a multi-step transmission having at least one input and one output shaft and at least two forward gears and at least one reverse gear.

[004] **BACKGROUND OF THE INVENTION**

[005] A similar arrangement is known from the Applicant's DE 198 58 553. It discloses a combination of one variator, one planetary transmission and a rear-mounted differential which distributes the driving power over two drive shafts. The power is branched behind the transmission input via a first branch to the variator and via a second branch and one other ratio step to the planetary transmission.

[006] Vehicle transmissions of that kind are also known, in general, from the prior art where a planetary transmission is rear-mounted on the continuously variable transmission, for example, a belt drive transmission. Said planetary transmissions are usually connected via two other spur gear sets with the axle differential of a motor vehicle, since the input and the output shafts of the planetary transmission have the same positive direction of rotation for the forward drive range and the positive direction of rotation is relayed via the inserted spur gear sets so that the drive axles connected with the axle differential also effect a positive direction of rotation during forward drive of the motor vehicle.

[007] Vehicle transmission of that kind are subject to a constant further development regarding reduction of construction cost or increase of comfort for the user of a motor vehicle equipped with such a transmission.

[008] It is, therefore, the problem on which this invention is based to indicate a design of a vehicle transmission which makes possible, on one hand, a lower construction cost and, on the other, an increase of comfort for the driver of a vehicle equipped with such a transmission. The reliability and the service life of the transmission are also to be increased.

[009] ————— According to the invention this problem is solved by a continuously variable vehicle transmission according to the characteristic features of claim 1.

[010] **SUMMARY OF THE INVENTION**

[011] It is proposed, in a vehicle transmission of the above kind, that between the input and the output shafts of the multi-step transmission a reversal of direction of rotation takes place by means of at least two forward gears and that the reverse gear(s) be designed without reversal of direction of rotation between the input and the output shafts of the transmission. Thereby is obtained in the first place that an advantageously lower construction cost be required compared to the known vehicle transmission with two driving ranges. By virtue of the reversal of direction of rotation within the transmission between the input and the output shafts, the formerly double spur gear set between the transmission and the rear-mounted axle differential is reduced to a single spur gear set. Secondly, the invention proposes a solution which makes possible a lesser variator spreading with a larger total spreading compared to one-range transmissions. Besides, an optimum variator rotational speed is possible in the main drive ranges which are divided, for example, in a city and a cross-country range.

[012] In a specially advantageous development of the invention, it is proposed that a variator is specially provided a cone pulley belt drive transmission or a reversing toroidal drive wherein the input and output shafts of the variator have the same direction of rotation and on the multi-step transmission there is rear-mounted, for reversal of direction of rotation, a device such as a simple spur gear set with a rotational speed ratio. Thereby the negative direction of rotation of the output shaft of the transmission during forward drive of the motor vehicle is, on one hand, reversed to a positive direction of rotation and, on the other, a rotational speed ratio is made possible, at the same time, by said spur gear set.

[013] The shafts of the variator and the multi-step transmission, the same as the wheel axles connected with the axle differential, are disposed side by side in parallel. Thereby a compact construction is advantageously made possible.

[020] It is advantageously provided to effect a change of the drive range as compound shift so that a stepped shift in the multi-step transmission and a ratio adjustment of the variator simultaneously occur. Thus, when shifting, for example, from the first to the second range, a shifting is effected wherein the total ratio of the vehicle transmission remains constant.

[021] **BRIEF DESCRIPTION OF THE DRAWINGS**

[022] Other objectives, features, advantages and possible application of the invention result from the description that follows of the embodiments shown in more detail in the drawings. All described and/or graphically shown features per se or in any logical combination form the object of the invention independently of their compilation in the claims and their reference to previous claims. In the drawings

[022] The invention will now be described, by way of example, with reference to the accompanying drawings in which:

[023] Fig. 1 diagrammatically shows a continuously variable vehicle transmission with a belt drive transmission and a rear-mounted transmission;

[024] Fig. 2 diagrammatically shows a continuously variable vehicle transmission with a two-way toroidal drive and a rear-mounted transmission;

[025] Fig. 3 shows a continuously variable vehicle transmission with a one-way toroidal drive and a rear-mounted transmission, the same as an axle differential;

[026] Fig. 4 shows a transmission similar to the representation in Fig. 1 but with a detailed diagrammatic representation of the planetary transmission;

[027] Fig. 5 shows the switching system for a planetary transmission according to the representation in Fig. 1; and

[028] Fig. 6 shows a graphic representation of the variator ratio relative to the total ratio for the three drive ranges.

[029] **DETAILED DESCRIPTION OF THE INVENTION**

[030] The continuously variable vehicle transmission 1 (Fig. 1) consists of one belt-drive transmission 2 as variator and rear-mounted thereon one multi-step

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JC13 Rec'd PCT/PTO 28 MAR 2002

[001] CONTINUOUSLY VARIABLE VEHICLE TRANSMISSION

[002]

[003] The invention relates to a continuously variable vehicle transmission having one variator such as a toroidal drive or a cone pulley belt drive for continuously variable ratio and a multi-step transmission having at least one input and one output shaft and at least two forward gears and at least one reverse gear.

[004]

[005] A similar arrangement is known from the Applicant's DE 198 58 553. It discloses a combination of one variator, one planetary transmission and a rear-mounted differential which distributes the driving power over two drive shafts. The power is branched behind the transmission input via a first branch to the variator and via a second branch and one other ratio step to the planetary transmission.

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[007] Vehicle transmission of that kind are subject to a constant further development regarding reduction of construction cost or increase of comfort for the user of a motor vehicle equipped with such a transmission.

[008] It is, therefore, the problem on which this invention is based to indicate a design of a vehicle transmission which makes possible, on one hand, a lower construction cost and, on the other, an increase of comfort for the driver of a vehicle equipped with such a transmission. The reliability and the service life of the transmission are also to be increased.

[009] According to the invention this problem is solved by a continuously variable vehicle transmission according to the characteristic features of claim 1.

[010]

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[013] The shafts of the variator and the multi-step transmission, the same as the wheel axles connected with the axle differential, are disposed side by side in parallel. Thereby a compact construction is advantageously made possible.

[014] In one other advantageous design of the invention, it is provided that the variator be specially designed as a one-way toroidal drive wherein a reversal of direction of rotation takes place in the variator between the input and the output shaft. Such an arrangement is advantageous for vehicles with low power range.

[015] The shafts of the one-way variator, the same as of the multi-step transmission, are disposed coaxially and consecutively relative to each other so that the wheel axle of the rear-mounted axle differential extends at right angle relative to the input shaft.

[016] The input and output shafts of the transmission are advantageously coaxial to each other and situated on one or both sides of the housing of the transmission. Thereby an adaptation of the transmission to the most different installation conditions in a motor vehicle is easily made possible.

[017] The multi-step transmission is advantageously designed as planetary transmission wherein a shift clutch of the multi-step transmission can also be advantageously designed as starting clutch. Alternatively, an external clutch can also be used, such as a wet starting clutch or a dry friction clutch, a hydrodynamic converter or also any other starting element, for example, a magnetic clutch, an E-motor, or the like.

[018] The multi-step transmission is advantageously designed power shiftably so that by means of multi-disk clutches a shift under load can be effected without interruption of the traction. Alternatively, a shift can also occur with traction interruption, with synchronizations, or also with a dog clutch.

[019] The reduction ratio of the reverse gear is advantageously unlike one and, in particular, amounts to about three so that a total or starting ratio of the inventive vehicle transmission of about fifteen can be obtained. Both forward drive ranges of the vehicle transmission are designed so as to have a cutting zone so that a "city range" and a "cross-country range" can be implemented. By this overlapping of the ranges, it is advantageously possible to prevent a frequent reversal of the ranges and an optimum variator speed is always made possible in the main drive ranges.

[020] It is advantageously provided to effect a change of the drive range as compound shift so that a stepped shift in the multi-step transmission and a ratio adjustment of the variator simultaneously occur. Thus, when shifting, for example, from the first to the second range, a shifting is effected wherein the total ratio of the vehicle transmission remains constant.

[021]

[022] Other objectives, features, advantages and possible application of the invention result from the description that follows of the embodiments shown in more detail in the drawings. All described and/or graphically shown features per se or in any logical combination form the object of the invention independently of their compilation in the claims and their reference to previous claims. In the drawings:

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[026] Fig. 4 shows a transmission similar to the representation in Fig. 1 but with a detailed diagrammatic representation of the planetary transmission;

[027] Fig. 5 shows the switching system for a planetary transmission according to the representation in Fig. 1; and

[028] Fig. 6 shows a graphic representation of the variator ratio relative to the total ratio for the three drive ranges.

[029]

[030] The continuously variable vehicle transmission 1 (Fig. 1) consists of one belt-drive transmission 2 as variator and rear-mounted thereon one multi-step transmission 4 which is specially designed as planetary transmission. Said continuously variable transmission is connected via a spur gear set 12 with

a rear-mounted axle differential 9 for driving the wheel axles 14, 15 of a motor vehicle.

[031] The driving power (shown by an arrow in Fig. 1) is transmitted by the input shaft 5, via the variator 2, to the variator output shaft 6; at the same time, the latter constitutes the input shaft 7 of the transmission 4. The positive direction of rotation of the input shaft 5 of the variator 2 remains positive up to the input shaft 7 of the transmission 4. In the transmission 4, as reversal of direction of rotation occurs in the forward drive ranges so that the output shaft 8 of the transmission 4 has a negative direction of rotation. The latter is reversed by means of the pinion 10 and of the wheel 11 again to a positive direction of rotation and via the input shaft 13 of the axle differential 9 is conveyed to the latter. During forward drive of the motor vehicle, the driving power leaves the axle differential 9 in positive direction of rotation via both wheel axles 14, 15.

[032] In the alternative, possible designs of the invention that follow, the same parts are identified with the same reference numerals insofar as this applies. The two-way toroidal drive 3 (Fig. 2) is driven, via the input shaft 16, in positive direction of rotation. Via both toroidal units 17 and 18, a continuously variable ratio occurs upon the spur gear 19 situated between the two toroidal units 17, 18 which has a negative direction of rotation. The latter is reversed to positive direction of rotation, via the spur gear set 22, with the spur gear 20 upon the output shaft 21 of the variator 3. The input shaft 7 of the transmission 4 and the rear-mounted parts and directions of rotation again correspond to the representation and description of Fig. 1.

[033] In the possible arrangements described above of the continuously variable vehicle transmission 1, the input shaft 5 of the variator 2, the input shaft 7 of the transmission 4 and the wheel axles 14 and 15 are disposed side by side in parallel in three-shafts construction. Alternatively an arrangement in standard construction is indicated in Fig. 3, that is, the shafts of the input shaft 5 of the variator 23 up to the input shaft 13 of the axle differential 9 are disposed coaxially consecutively. The variator 23 (Fig. 3) is designed as one-way toroidal drive so that the positive direction of rotation of the input shaft 5 is reversed to a negative direction of

rotation of the output shaft 6. The input shaft 7 of the transmission 4 thus rotates also in negative direction of rotation. According to the invention, the direction of rotation within the transmission 4 -- for the forward drive ranges -- is reversed to a positive direction of rotation of the output shaft 8. This positive direction of rotation is relayed via the input shaft 13 of the axle differential 9 to the wheel axles 14 and 15.

[034] The transmission 4 (Fig. 4) is designed, for example, as two-speed planetary gear. Here are provided four clutches A, B, C, D for shifting the two forward drive ranges V1 and V2, the same as the reverse drive range R (Fig. 5). The clutches A and D are shifted for the first forward drive range V1. To shift from the first to the second driving range V2, the clutch B is shifted instead of A. The clutch D remains closed. In the reverse drive range R, the clutches A and C are shifted.

[035] In Fig. 6 is shown upon the abscissa the total ratio i_{ges} of the continuously variable vehicle transmission at a constant driving rotational speed n_{an} . The variator ratio is shown upon the ordinate. The total ratio i_{ges} is divided in three driving ranges, the negative total ratio of the reverse driving range being covered with the reverse driving ratio 24. The positive total ratio in the forward drive range is reproduced in a first range with the first forward drive ratio 25, the same as the second forward drive range with the second forward drive ratio 26. Said two ranges 25 and 26 are laid out so as to overlap in an intersection area 27, that is, a "city range" and a "cross-country range" can be implemented.

[036] The shifting according to the invention takes place as compound power shift, there simultaneously occurring a stepped shifting in the multi-step transmission and a ratio adjustment of the variator. Even through this results in a momentary collapse during the shifting, no change of the total ratio i_{ges} results, that is, the motor rotational speed does not change. This can be seen by the fact that the total ratio i_{ges} at the shifting point 28 of the first forward drive range 25 is identical with the ratio i_{ges} adjusted after the shifting point 29 of the second forward drive range.

Reference numerals

1 vehicle transmission, continuously variable	15 wheel axle
2 variator/belt drive transmission	16 input shaft
3 variator/toroidal drive, two-way	17 toroidal unit
4 transmission, multi-step	18 toroidal unit
5 input shaft	19 spur gear
6 output shaft	20 spur gear
7 input shaft	21 output shaft
8 output shaft	22 spur gear step
9 axle differential	23 variator/toroidal drive, one-way
10 pinion	24 reverse ratio
11 wheel	25 first forward ratio
12 spur gear set	26 second forward ratio
13 input shaft	27 overlapping area
14 wheel axle	28 shifting point
	29 shifting point

Claims

1. Continuously variable vehicle transmission (1) having a variator (2, 3, 23) such as a toroidal drive or a cone pulley belt drive transmission for continuously variable ratio adjustment and a multi-step transmission (4) with at least one input (7) and one output (8) shaft and at least two forward gears and at least one reverse gear, characterized in that in said multi-step transmission (4) a reversal of direction of rotation takes place between said input (7) and said output (8) shaft by means of at least two forward gears and the reverse gear(s) is/are designed without reversal of direction of rotation between said input (7) and said output (8) shaft.
2. Continuously variable vehicle transmission according to claim 1, characterized in that as variator is specially provided one cone pulley belt drive transmission (2) or a two-way toroidal drive (3), the input (5, 16) and output (6, 21) of said variator having the same direction of rotation, and that on the multi-step transmission (4), for reversal of direction of rotation, a device is rear-mounted, for ex., a spur gear set (12) specially with a rotational speed ratio.
3. Continuously variable vehicle transmission according to claim 2, characterized in that said shafts (5, 6) of said variator (2, 3) and said shafts (16, 21) of said multi-step transmission (4) are disposed side by side in parallel.
4. Continuously variable vehicle transmission according to claim 1, characterized in that said variator is particularly designed as one-way toroidal drive (23) and a reversal of direction of rotation takes place in said variator (23) between said input (5) and said output (6) shaft.
5. Continuously variable vehicle transmission according to claim 4, characterized in that said shafts (5, 6) of said variator (23) and said shafts (7, 8) of said multi-step transmission (4) are disposed coaxially consecutively.
6. Continuously variable vehicle transmission according to any one of the preceding claims, characterized in that said input (7) and said output (8) shafts of said transmission (4) are coaxial to each other and situated on one or both sides of the housing of said transmission (4).

7. Continuously variable vehicle transmission according to any one of the preceding claims, characterized in that said multi-step transmission (4) is designed as planetary transmission.

8. Continuously variable vehicle transmission according any one of the preceding claims, characterized in that a shift clutch of said multi-step transmission (4) is designed as starting clutch.

9. Continuously variable vehicle transmission according to any one of the preceding claims, characterized in that said multi-step transmission (4) is power-shiftably designed.

10. Continuously variable vehicle transmission according any one of the preceding claims, characterized in that two forward drive ranges are shiftable and have an overlapping range (27).

11. Continuously variable vehicle transmission according any one of the preceding claims, characterized in that two forward drive ranges are shiftable and have an overlapping range (27).

12. Continuously variable vehicle transmission according to claim 11, characterized in that a change of the drive range as group shifting is possible, there simultaneously occurring a stepped shift in said multi-step transmission (4) and a ratio adjustment of said variator (2, 3, 23).

ABSTRACT OF THE DISCLOSURE

A continuously variable vehicle transmission (1) having one variator (2), for ex., a belt drive transmission, for continuous ratio adjustment and a multi-step transmission (4), for ex., a planetary transmission having at least one input and one output shaft (7, 8) and at least two forward gears and at least one reverse gear. According to the invention a reversal of direction of rotation takes place between the input and the output shaft (7, 8) in the multi-step transmission (4) by means of the two or more forward gears and the reverse gear(s) is/are designed so that no reversal of direction of rotation occurs between the input and the output shaft (7, 8).

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Fig. 1

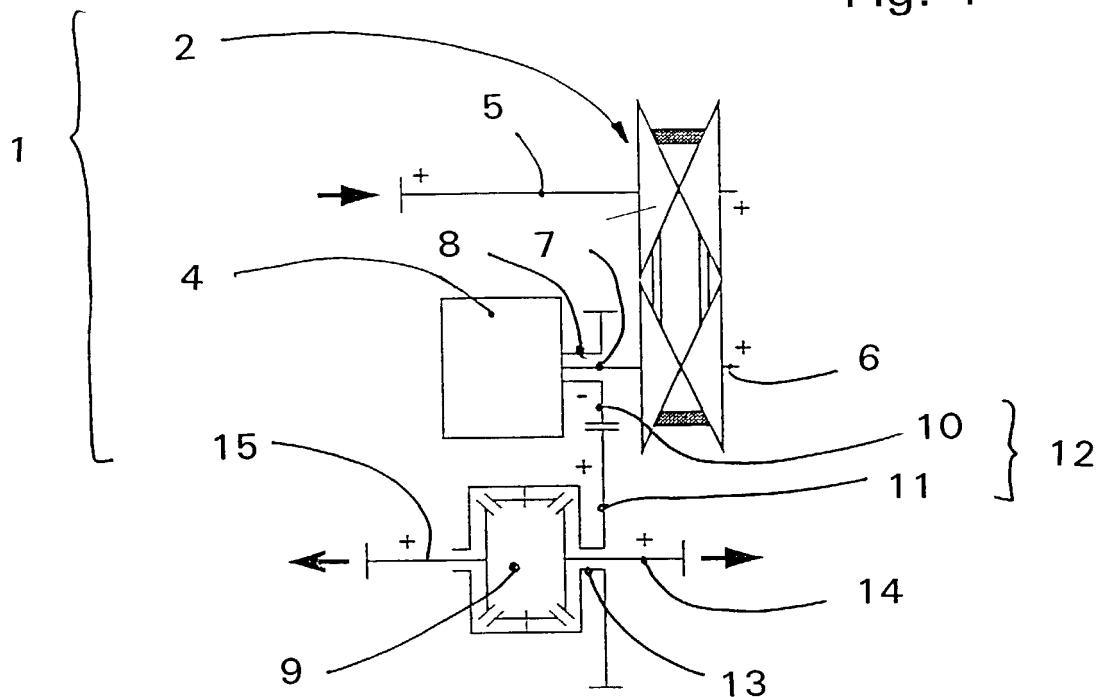
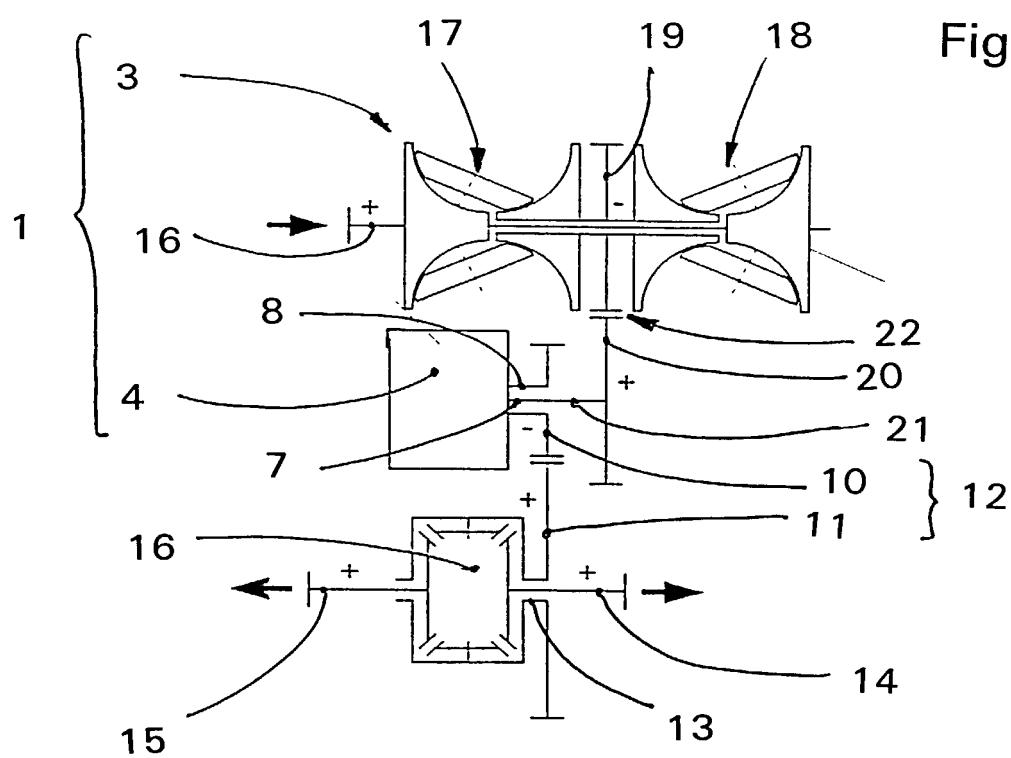


Fig. 2



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Fig. 3

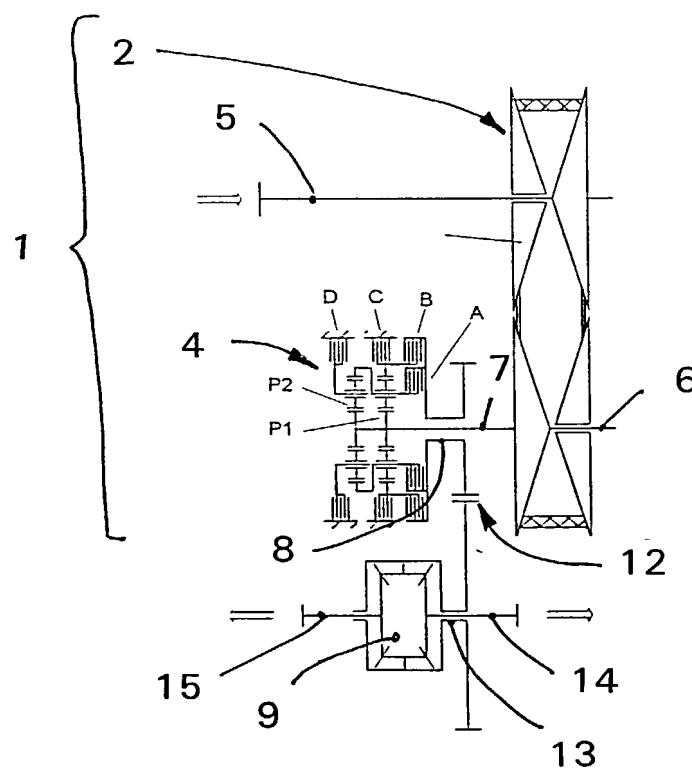
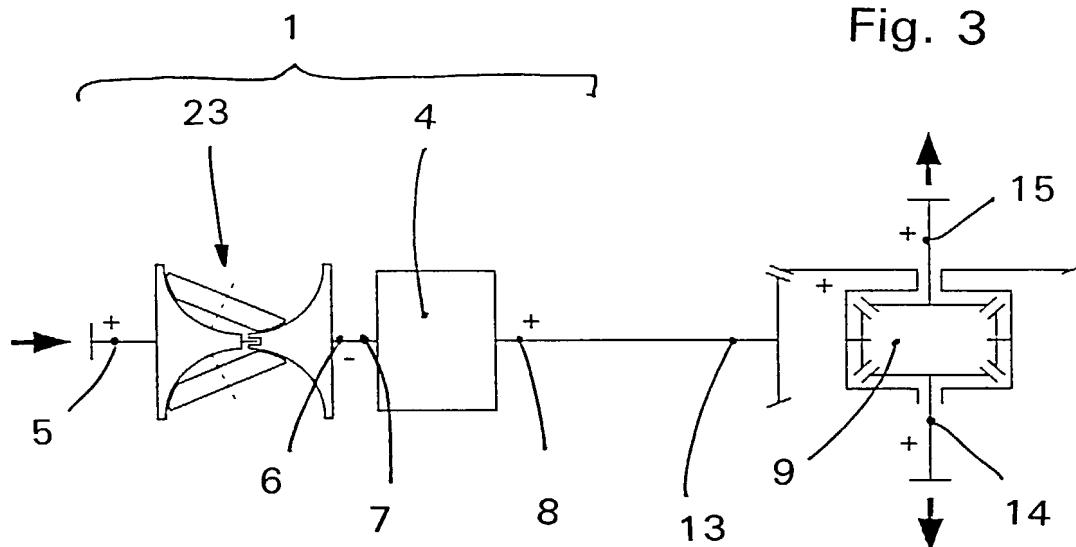


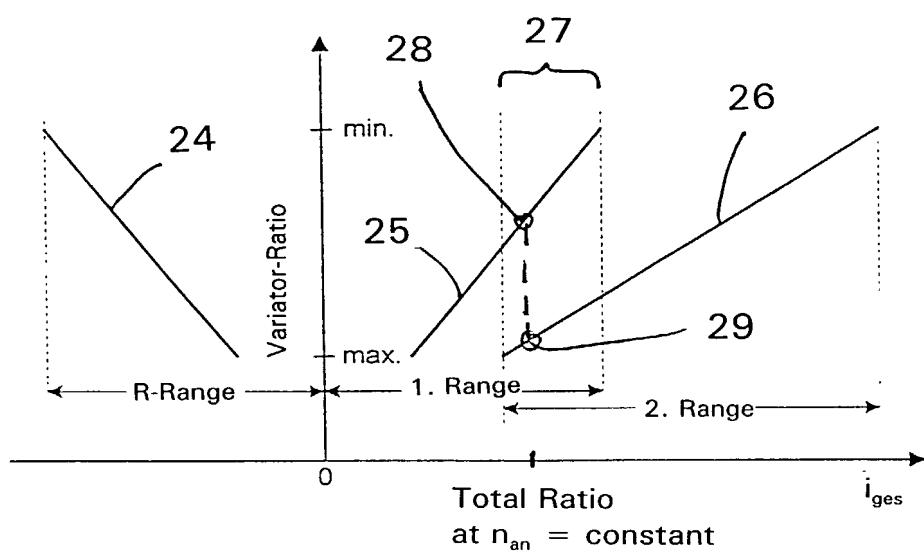
Fig. 4

Fig. 5

	A	B	C	D
V1	x			x
V2		x		x
R	x		x	

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Fig. 6



COMBINED DECLARATION AND POWER OF ATTORNEY
(Original, Design, National Stage of PCT, Supplemental)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: (check one applicable item below)

original
design
supplemental
 National Stage of PCT
divisional (see added page)
continuation (see added page)
continuation-in-part (see added page)

INVENTORSHIP IDENTIFICATION

My residence, post office address and citizenship are as stated below next to my name. I believe that the original, first and sole inventor (*if only one name is listed below*) an original, first and joint inventors (*if plural names are listed below*) of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

CONTINUOUSLY VARIABLE VEHICLE TRANSMISSION

SPECIFICATION IDENTIFICATION

The specification of which: (complete (a), (b) or (c))

(a) is attached hereto.
 (b) was filed on _____ as " Serial No. _____
 0 / _____ or " Express Mail No. _____ (as Serial _____
 No. not yet known) _____ and was amended on _____ (if
 applicable).
 (c) was described and claimed in PCT International
 Application No. PCT/EP00/09990 filed on
11 October 2000 (11.10.2000) and as amended under PCT
 Article 19 on _____ (if any).

POWER OF ATTORNEY

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name(s) and registration number(s))

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Attached as part of this Declaration and Power of Attorney is the authorization of the above-named attorney(s) to accept and follow instructions from my representative(s).

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ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent Office all information which is known to be material to patentability of this application as defined in § 1.56 of Title 37 of the Code of Federal Regulations.

PRIORITY CLAIM

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

EARLIEST FOREIGN APPLICATION(S), IF ANY FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

COUNTRY	APPLICATION NO.	DATE OF FILING (day,month,year)	PRIORITY CLAIMED UNDER 37 USC 119
Fed. Rep. of Germany	199 50 053.3	(16.10.99) 16. October 1999	<input checked="" type="checkbox"/> YES NO
			YES NO
			YES NO
			YES NO
			YES NO

ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signature(s)

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Inventor's signature  Date 02-01-31

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